Electronic Services - Hayward, Ca
M18306X

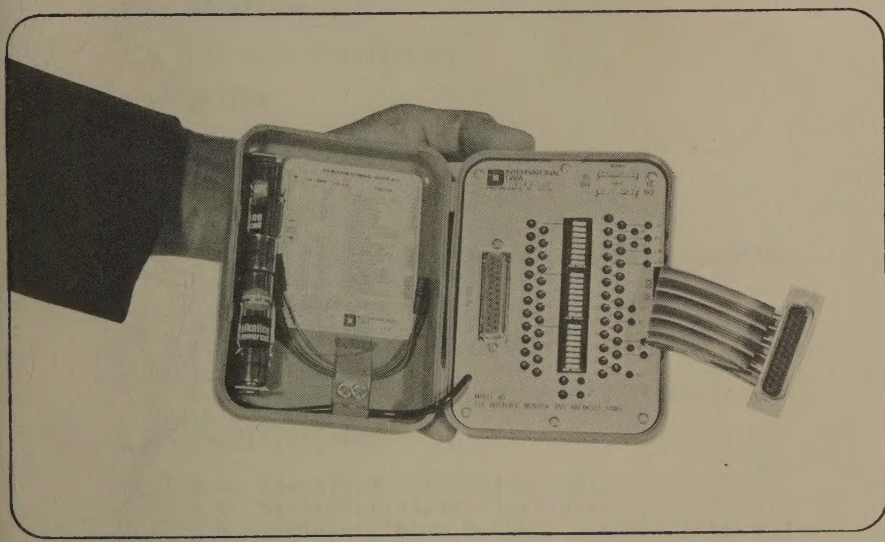
INTERNATIONAL DATA SCIENCES, INC.

ADVANCED TECHNIQUES IN DATA COMMUNICATIONS

MANUAL OF OPERATION FOR MODEL 60 EIA INTERFACE MONITOR AND BREAKOUT PANEL

7 WELLINGTON ROAD, LINCOLN, R.I. 02865, TEL. 401-333-6200
TWX (710) 384-1911

MANUAL OF OPERATION
FOR
MODEL 60
EIA INTERFACE MONITOR
AND
BREAKOUT PANEL



© Copyright International Data Sciences, Inc. 1978
U.S. Patent Number D-241726

6-903-0102

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General Description

2.0 OPERATION

3.0 EIA RS-232 INTERFACE

4.0 OPTION

4.1 Rechargeable Unit

5.0 APPLICATIONS

5.1 Monitoring the Modem-Terminal Interface
5.2 Modem Loop-Back Test
5.3 Monitoring EIA Line Transitions
5.4 EIA Line Attenuation Test
5.5 Model 60 LED Lamp Test
5.6 EIA Signal Test
5.7 Non-Standard Modem-Terminal Interfaces

6.0 SPECIFICATIONS

6.1 Electrical Specifications
6.2 Mechanical Specifications
6.3 Nickel-Cadmium Battery Specifications
6.4 Charging Specifications
6.5 Temperature Specifications

CALIBRATION & REPAIR SERVICE

WARRANTY

LIST OF FIGURES

Figure 1.0-1	Model 60 Ploypropylene Molded Case
Figure 1.0-2	Model 60 EIA Interface and Breakout Panel
Figure 1.1	Model 60 Line Drawing
Figure 2.0-1	Typical EIA RS-232 Line Through Model 60
Figure 2.0-2	Model 60 EIA/CCITT Interface Decal
Figure 3.0	Typical System Application
Figure 4.1	Rechargeable Unit Option
Figure 5.1	Monitoring the Modem-Terminal Interface
Figure 5.2	Modem Loop-Back Test Connection
Figure 5.3	Monitoring EIA Line Transitions
Figure 5.4-1	EIA Line Attenuation Test Connection
Figure 5.4-2	Resistor Attenuator
Figure 5.5	LED Lamp Test
Figure 5.6	EIA Signal Test

LIST OF TABLES AND CHARTS

Table 3.0-1	EIA/CCITT Interface Description
Chart 1	Voltage Thresholds for RS-232 Lines

1.0 INTRODUCTION

The Model 60 EIA Interface Monitor and Breakout Panel is a portable, pocket-size test set designed to monitor and access all 25 conductors of EIA RS-232 and CCITT V.24 Interface between a data modem and data terminal. It is housed in a durable polypropylene injected molded case with an integral living hinged cover that is guaranteed for 70,000,000 flex cycles. See Figures 1.0-1 and 1.0-2. Two size "AA" Alkaline batteries provide a self-contained power source capable of over 100 hours of continuous use.

1.1 General Description

The following general description refers to the line drawing of the Model 60 shown in Figure 1.1.

(1) Batteries

Two size "AA" Alkaline batteries provide a power source capable of over 100 hours of continuous use. Two Ni-Cad batteries are used when the rechargeable unit option is installed.

(2) Model 60 Interface Decal

This decal mounted inside the cover lists the pin number, common mnemonic name, direction, function, and standard circuit designation for all signals of the EIA/CCITT Interface.

(3) TO DTE

A female 25-pin EIA connector used to connect the Model 60 to Data Terminal Equipment.

(4) Test Points

Test points on each side of each switch allow monitoring and cross-patching of all interface signals.

(5) LED Indicators

Twelve LEDs monitor key interface signals.

(6) TO DCE

A male 25-pin EIA connector, attached to a seven-inch ribbon cable, used to directly connect the Model 60 to Data Communication Equipment.

(7) IN+ and IN- Circuits

The IN+ and IN- circuits measure input signals to determine whether they meet EIA specifications.

FIGURE 1.0-1. MODEL 60's POLYPROPYLENE MOLDED CASE

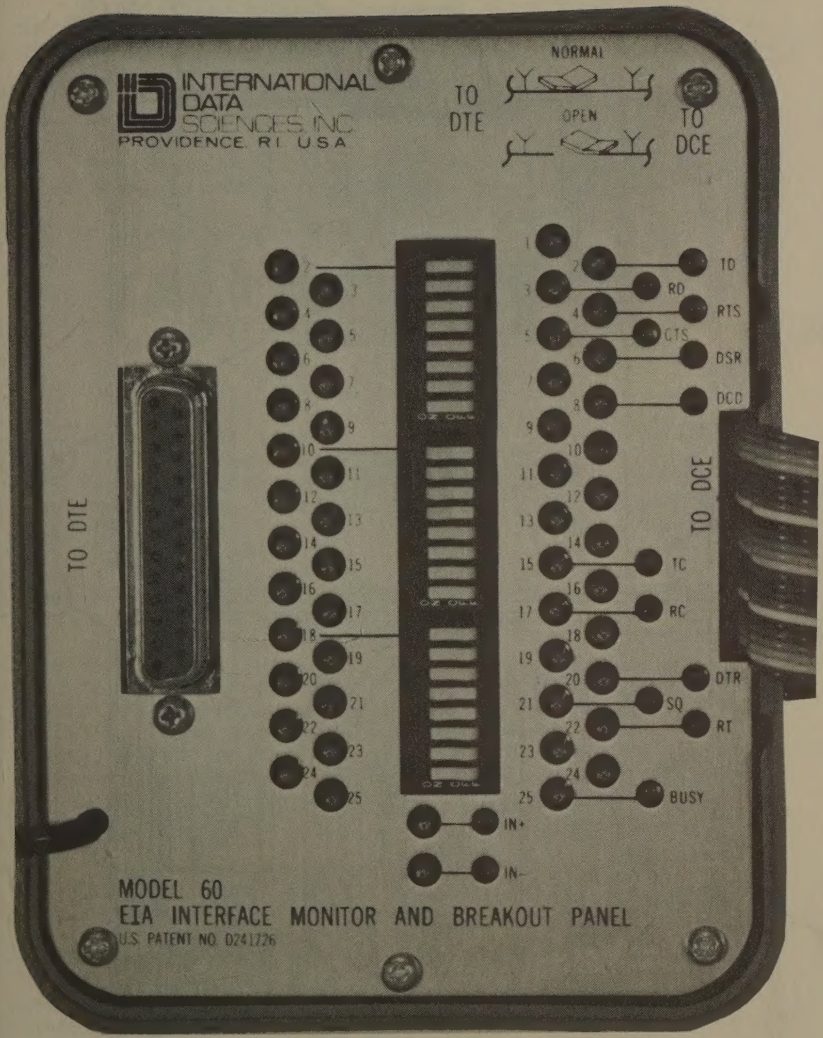
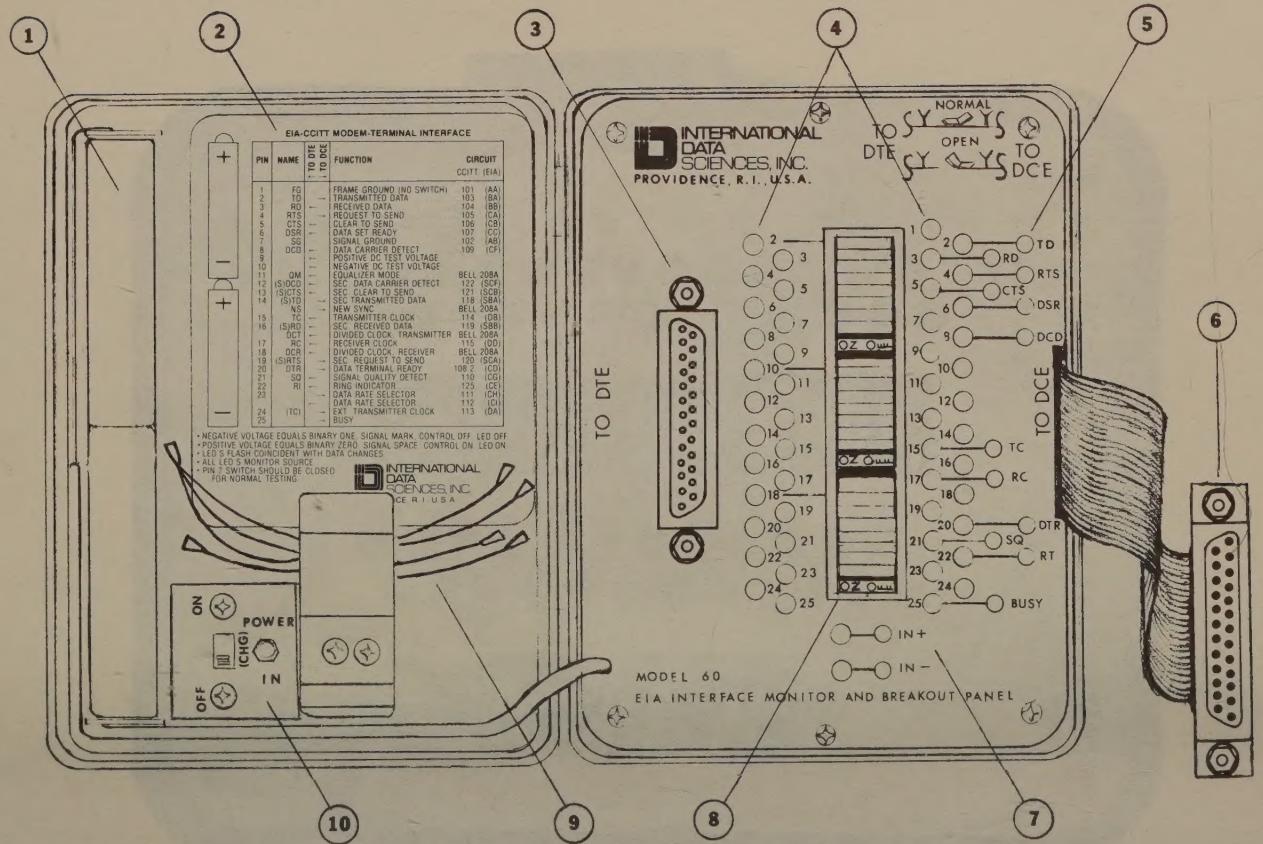


FIGURE 1.0-2. MODEL 60 EIA INTERFACE MONITOR AND BREAKOUT PANEL


1
2
3
4
5
6
7
8
9
10
EIA-CCITT MODEM-TERMINAL INTERFACE
PIN
NAME
TO DTE
TO DCE
FUNCTION
CIRCUIT
CCITT (EIA)
1 FG FRAME GROUND (NO SWITCH) 101 (AA)
2 TD TRANSMITTED DATA 103 (BA)
3 RD RECEIVED DATA 104 (BB)
4 RTS REQUEST TO SEND 105 (CA)
5 CTS CLEAR TO SEND 106 (CB)
6 DSR DATA SET READY 107 (CC)
7 SG SIGNAL GROUND 102 (AB)
8 DCD DATA CARRIER DETECT 109 (CF)
9 POSITIVE DC TEST VOLTAGE
10 NEGATIVE DC TEST VOLTAGE
11 QM EQUALIZER MODE BELL 208A
12 (S)OCD SEC. DATA CARRIER DETECT 122 (SCF)
13 (S)CTS SEC. CLEAR TO SEND 121 (SCB)
14 (S)TD SEC TRANSMITTED DATA 118 (SBA)
NS NEW SYNC BELL 208A
15 TC TRANSMITTER CLOCK 114 (DB)
16 (S)RD SEC. RECEIVED DATA 119 (SBB)
DCT DIVIDED CLOCK, TRANSMITTER BELL 208A
17 RC RECEIVER CLOCK 115 (DD)
18 DCR DIVIDED CLOCK, RECEIVER BELL 208A
19 (S)RTS SEC. REQUEST TO SEND 120 (SCA)
20 DTR DATA TERMINAL READY 108.2 (CD)
21 SQ SIGNAL QUALITY DETECT 110 (CG)
22 RI RING INDICATOR 125 (CE)
23 DATA RATE SELECTOR 111 (CH)
DATA RATE SELECTOR 112 (CI)
24 (TCI) EXT. TRANSMITTER CLOCK 113 (DA)
25 BUSY
• NEGATIVE VOLTAGE EQUALS BINARY ONE, SIGNAL MARK, CONTROL OFF, LED OFF
• POSITIVE VOLTAGE EQUALS BINARY ZERO, SIGNAL SPACE, CONTROL ON, LED ON
• LED'S FLASH COINCIDENT WITH DATA CHANGES
• ALL LED'S MONITOR SOURCE
• PIN 7 SWITCH SHOULD BE CLOSED FOR NORMAL TESTING
INTERNATIONAL DATA SCIENCES, INC.
PROVIDENCE, R.I., U.S.A.
ON
POWER
CHGI
OFF
IN
INTERNATIONAL DATA SCIENCES, INC.
PROVIDENCE, R.I., U.S.A.
NORMAL
TO DTE
OPEN
TO DCE
TO DTE
TO DCE
TD
RD
RTS
CTS
DSR
DCD
TC
RC
DTR
SQ
RT
BUSY
IN+
IN−
MODEL 60
EIA INTERFACE MONITOR AND BREAKOUT PANEL

(8) Miniature Switches

Twenty-four miniature ON/OFF switches allow all interface conductors (except frame ground on pin 1) to be individually interrupted for isolated testing and observation.

(9) Jumper Cables

Miniature jumper cables, stored inside the cover, used for cross-patching signal lines.

(10) Rechargeable Unit (Option)

The rechargeable unit allows the Model 60 to operate with rechargeable Ni-Cad batteries or from a 115 VAC, 60 Hz or 230 VAC, 50 Hz line.

2.0 OPERATION

In use, the operator unplugs the EIA RS-232 Interface cable at the modem and plugs it into the Model 60's 25-pin female connector labeled "TO DTE" (Data Terminal Equipment). The Model 60's male connector, labeled "TO DCE" (Data Communication Equipment) and attached to a 7-inch ribbon cable, is connected directly to the modem. This allows access to all signal conductors of the 25-wire EIA RS-232 Interface.

The Model 60 monitors 12 key interface signals with EIA RS-232 sensing circuits which drive 12 LEDs to indicate the ON or OFF levels. Figure 2.0-1 shows a schematic diagram of a typical EIA RS-232 line through the Model 60. Two additional LEDs, labeled IN+ and IN-, sense either positive or negative voltage levels between ±3V and ±25V and may be used to monitor any signal line. All Model 60 sensing circuits are high impedance and will not load lines.

Twenty-four miniature switches allow all interface conductors (except frame ground on Pin 1) to be individually interrupted for isolated testing and observation of terminal and modem lines. Pins on each side of each switch and small jumper cables, which are stored in the cover, allow cross-patching and monitoring of all interface signals. Thus, signals can be re-routed to pins by opening lines utilizing the miniature switches, and cross-patching utilizing the jumpers. The chart shown in Figure 2.0-2 is mounted inside the front cover of each unit and gives the pin number, common mnemonic name, direction, function, and standard circuit designation for each of the 25 signals in the EIA/CCITT Interface.

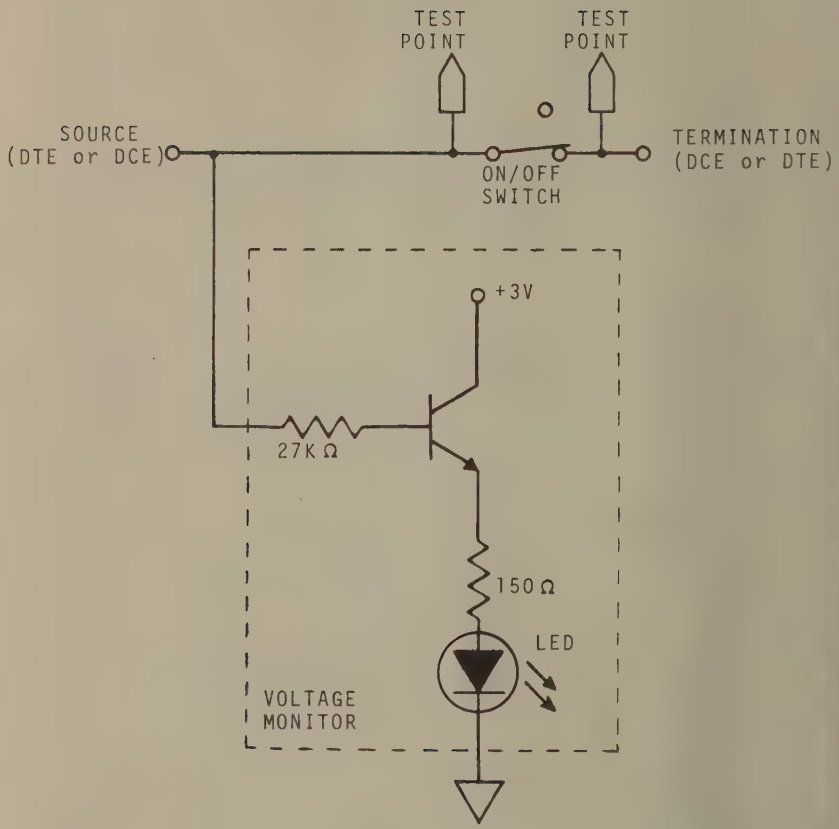


FIGURE 2.0-1. TYPICAL EIA RS-232 LINE THROUGH MODEL 60

EIA-CCITT MODEM-TERMINAL INTERFACE

PIN	NAME	↑ TO DTE ↓ TO DCE	FUNCTION	CIRCUIT CCITT	(EIA)
1	FG		FRAME GROUND (NO SWITCH)	101	(AA)
2	TD	→	TRANSMITTED DATA	103	(BA)
3	RD	←	RECEIVED DATA	104	(BB)
4	RTS	→	REQUEST TO SEND	105	(CA)
5	CTS	←	CLEAR TO SEND	106	(CB)
6	DSR	←	DATA SET READY	107	(CC)
7	SG		SIGNAL GROUND	102	(AB)
8	DCD	←	DATA CARRIER DETECT	109	(CF)
9		←	POSITIVE DC TEST VOLTAGE		
10		←	NEGATIVE DC TEST VOLTAGE		
11	QM	←	EQUALIZER MODE	BELL 208A	
12	(S)DCD	←	SEC. DATA CARRIER DETECT	122	(SCF)
13	(S)CTS	←	SEC. CLEAR TO SEND	121	(SCB)
14	(S)TD	→	SEC TRANSMITTED DATA	118	(SBA)
	NS	→	NEW SYNC	BELL 208A	
15	TC	←	TRANSMITTER CLOCK	114	(DB)
16	(S)RD	←	SEC. RECEIVED DATA	119	(SBB)
	DCT	←	DIVIDED CLOCK, TRANSMITTER	BELL 208A	
17	RC	←	RECEIVER CLOCK	115	(DD)
18	DCR	←	DIVIDED CLOCK, RECEIVER	BELL 208A	
19	(S)RTS	→	SEC. REQUEST TO SEND	120	(SCA)
20	DTR	→	DATA TERMINAL READY	108.2	(CD)
21	SQ	←	SIGNAL QUALITY DETECT	110	(CG)
22	RI	←	RING INDICATOR	125	(CE)
23		→	DATA RATE SELECTOR	111	(CH)
		←	DATA RATE SELECTOR	112	(CI)
24	(TC)	→	EXT. TRANSMITTER CLOCK	113	(DA)
25		→	BUSY		

- NEGATIVE VOLTAGE EQUALS BINARY ONE, SIGNAL MARK, CONTROL OFF, LED OFF.
- POSITIVE VOLTAGE EQUALS BINARY ZERO, SIGNAL SPACE, CONTROL ON, LED ON
- LED'S FLASH COINCIDENT WITH DATA CHANGES
- ALL LED'S MONITOR SOURCE.
- PIN 7 SWITCH SHOULD BE CLOSED FOR NORMAL TESTING

INTERNATIONAL DATA SCIENCES, INC.
PROVIDENCE, R. I., U. S. A.

FIGURE 2.0-2. MODEL 60 EIA/CCITT INTERFACE DECAL

3.0 EIA RS-232 INTERFACE

The EIA RS-232 Interface is the U.S. set of signal protocol standards as specified by the Electronic Industries Association for DCE (Data Communication Equipment) - DTE (Data Terminal Equipment) connections. The international standard for the same interface is CCITT V.24. The need for this universal standard is apparent, due to the many vendors of data communication equipment.

The hardware interfacing is performed within the electronics of the modem. However, this discussion will be limited to an interfacing protocol that occurs at the modems (DCE) EIA connector. An EIA cable is used to connect the terminal (DTE) to the modem. This EIA cable employs 25 signal conductors, with each lead identified by a number. The EIA/CCITT standards define the function for each signal conductor and corresponding pin. See Table 3.0-1.

It would be unusual for a system to use all 25 signal conductors. A typical interface will use approximately one-half of the available functions, based on the designer's application, and the remaining leads would be ignored. See Figure 3.0.

The EIA interface can be divided into three types of functions: control, clocking, and data. Control signals make up the so called "EIA hand-shaking signals" that take place between the modem and terminal; these signals are either "ON" or "OFF". Clocking signals control the speed and synchronization of the data transfer. Data signals represent the actual transmission of information.

Before data can be transmitted or received, certain conditions must be met. First the terminal must place the Data Terminal Ready signal on Pin 20 to the "ON" state. This control signal tells the modem that the terminal is powered up, is not in a test mode, and is ready to be connected to the communication channel. The modem now places the Data Set Ready signal on Pin 6 to the "ON" state. This control signal, similar to DTR, tells the terminal that the modem is powered up and is not in a test mode.

The conditioning of these control signals does not mean that data can be transmitted. Depending on the particular telephone line (dial-up, or point-to-point) the modem may be required to do more signaling before data can be passed.

But assuming both Ready functions are on, two additional signals must be enabled before data is transmitted. When the enter key on the terminal is pressed, the terminal turns on the Request To Send control signal (Pin 4) and tells the modem to prepare to send data as soon as possible. The modem then synchronizes itself with the remote modem by adjusting the equalizer mode,

TABLE 3.0-1. EIA/CCITT INTERFACE DESCRIPTION

PIN #	MNEMONIC NAME	DIRECTION		CIRCUIT		DESCRIPTION
		TO DTE ←	TO DCE →	EIA	CCITT	
1	FG			AA	101	FRAME GROUND - This lead is an electrical equipment frame and power ground.
2	TD		→	BA	103	TRANSMITTED DATA - This lead carries the serial digital data transmitted from the DTE to the DCE.
3	RD	←		BB	104	RECEIVED DATA - This lead carries the serial digital data received at the DTE.
4	RTS		→	CA	105	REQUEST TO SEND - An "ON" condition on this lead is used to enable the local DCE for data transmission.
5	CTS	←		CB	106	CLEAR TO SEND - An "ON" condition on this lead indicates whether or not the DCE is ready to transmit data.
6	DSR	←		CC	107	DATA SET READY - An "ON" condition on this lead indicates that the local DCE is ready to process data and is not in a test, talk, or dial mode.
7	SG			AB	102	SIGNAL GROUND - This lead establishes the common ground reference potential for all circuits except frame ground on pin 1.
8	DCD	←		CF	109	DATA CARRIER DETECT (Received Line Signal Detector)- This lead indicates that data from the remote location is being received and meets a suitable criteria established by the DCE manufacturer.
9		←				Positive DC Test Voltage
10		←				Negative DC Test Voltage
11	QM	←		BELL	208A	EQUALIZER MODE - This lead is used to indicate to the DTE that the adaptive equalizer in the receiver is reset automatically when error performance is poor. (non-EIA designated).
12	(S)DCE	←		SCF	122	SECONDARY DATA CARRIER DETECT - This lead is equivalent to DCD on pin 8 except that it indicates the proper reception of the secondary channel line signal instead of the primary channel received line signal.

TABLE 3.0-1 EIA/CCITT INTERFACE DESCRIPTION (cont.)

PIN #	MNEMONIC NAME	DIRECTION TO DTE ←	DIRECTION TO DCE →	CIRCUIT EIA	CIRCUIT CCITT	DESCRIPTION
13	(S)CTS	←		SCB	121	SECONDARY CLEAR TO SEND - This lead is equivalent to CTS on pin 5 except that is indicates the availability of the secondary channel instead of indicating the availability of the primary channel to transmit data.
14	(S)TD		→	SBA	118	SECONDARY TRANSMITTED DATA - This lead is equivalent to TD on pin 2 except that is is used to transmit data via the secondary channel.
	NS		→	BELL 208A		NEW SYNC - This lead may be used on an optional basis with the DCE at a master station of a multistation private line network, such as in a polling operation, to ensure rapid resynchronization of the receiver on data from many different remote transmitters (non-EIA designated).
15	TC	←		DB	114	TRANSMITTER CLOCK - This lead is used to provide the DTE with signal element timing information.
16	(S)RD	←		SBB	119	SECONDARY RECEIVED DATA - This lead is equivalent to RD on pin 3 except that is is used to receive data on the secondary channel.
	DCT	←		BELL 208A		DIVIDED CLOCK, TRANSMITTER - A square-wave signal at one-third the nominal bit rate appears on this lead whenever power is supplied to the DCE. (non-EIA designated).
17	RC	←		DD	115	RECEIVER CLOCK - This lead is used to provide the DTE with received signal element timing information.
18	DCR	←		BELL 208A		DIVIDED CLOCK, RECEIVER - A square-wave signal on this lead provides the receiver timing information at one-third the nominal bit rate. (non-EIA designated).
19	(S)RTS		→	SCA	120	SECONDARY REQUEST TO SEND - This lead is equivalent to RTS on pin 4 except that is requests to use the secondary channel instead of the primary data channel.

TABLE 3.0-1. EIA/CCITT INTERFACE DESCRIPTION (cont.)

PIN #	MNEMONIC NAME	DIRECTION		CIRCUIT		DESCRIPTION
		TO DTE ←	TO DCE →	EIA	CCITT	
20	DTR		→	CD	108.2	DATA TERMINAL READY - An "ON" condition on this lead indicates that the DCE is ready to be connected to the communication channel.
21	SQ	←		CG	110	SIGNAL QUALITY DETECT - This lead is used to indicate whether or not there is a high probability of an error in the received data.
22	RI	←		CE	125	RING INDICATOR - An "ON" condition on this lead indicates that a ringing signal is being received on the communication channel.
23			→	CH	111	DATA RATE SELECTOR - This lead is used to select between the two data signalling rates in the case of dual rate DCE.
		←		CI	112	DATA RATE SELECTOR - This lead is used to select between the two data signalling rates in the case of dual rate DCE.
24	TC		→	DA	113	EXTERNAL TRANSMITTER CLOCK - This lead is used to provide the transmitting signal converter with signal element timing information.
25			→	BELL 208A		BUSY - This lead is used for testing purposes by Telephone Company personnel. (non-EIA designated).

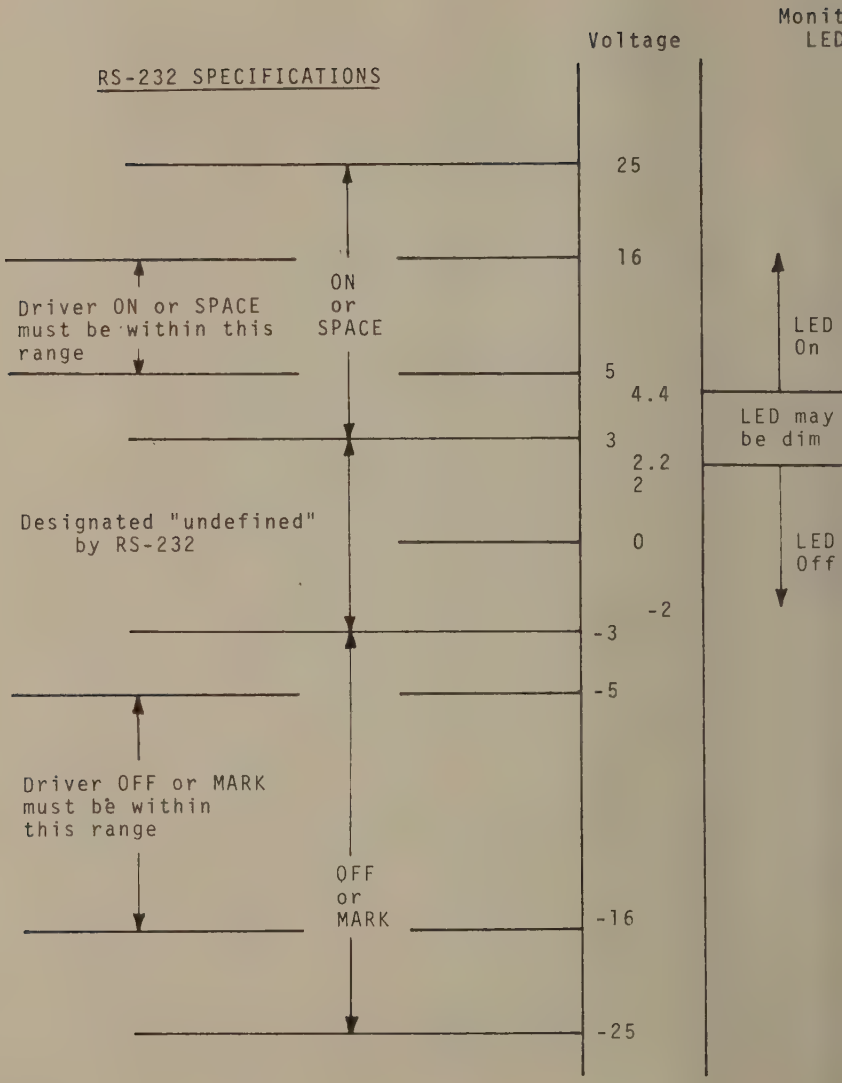


CHART 1. VOLTAGE THRESHOLDS FOR RS-232 LINES

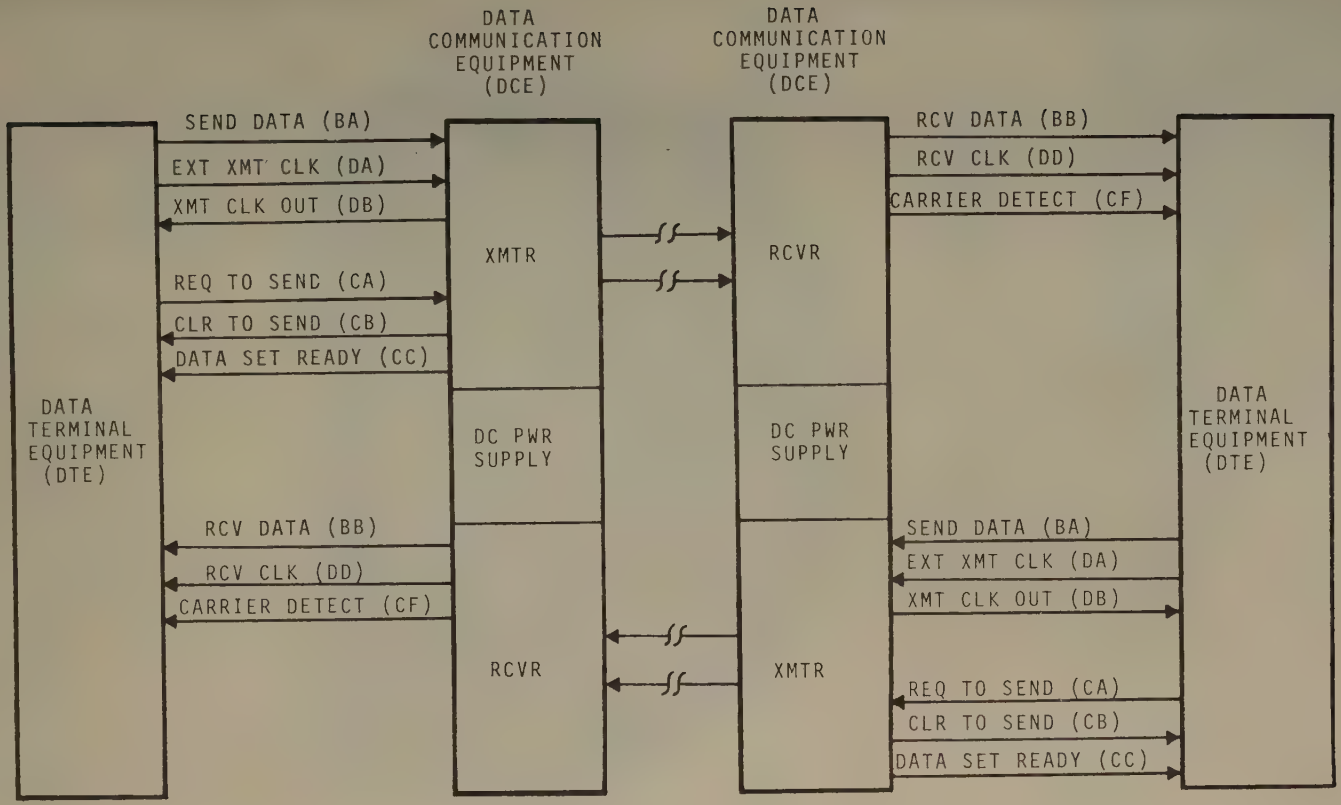


FIGURE 3.0. TYPICAL SYSTEM APPLICATION

receive clock, and other clocking signals. When this is completed the modem turns on the Clear To Send signal (Pin 5) which tells the terminal that conditions have been met to begin transmitting data.

The Transmitter Clock signal, supplied by the Modem (Pin 15) or by the terminal (Pin 24), provides synchronization between the modem processing the transmitted data and the terminal sending it. Another clocking signal, Receiver Clock (Pin 17), provides received data signal timing.

This brief introduction to the EIA/CCITT Interface is meant to be helpful in understanding the signal protocols that take place between the modem and terminal so the Model 60 can be used more effectively.

4.0 OPTIONS

4.1 Rechargeable Unit

The Rechargeable Unit option provides the Model 60 with added versatility by increasing the effective battery life to accept over 1000 recharging cycles. After being fully charged, the operating life prior to the next recharging cycle is 10 hours under continuous full-load operation. The Rechargeable Unit also allows the Model 60 to be operated from a 115 VAC, 60 Hz or 230 VAC, 50 Hz power source.

The Rechargeable Unit option includes:

1. Two size AA, 1.2V No. CF15 Eveready Nickel-Cadmium batteries or equivalent.
2. A power ON/OFF switch that disables all circuitry while recharging or allows the Model 60 to be used during a recharging cycle.
3. An AC Adaptor/Charger unit which plugs into any 110 VAC, 60 Hz power source. (220 VAC, 50 Hz unit also available)
4. A plug-in jack to accept a 0.097" (2.5 mm) diameter jack sleeve on the charging unit.

Figure 4.1 shows the entire option installed inside the top cover of the Model 60.

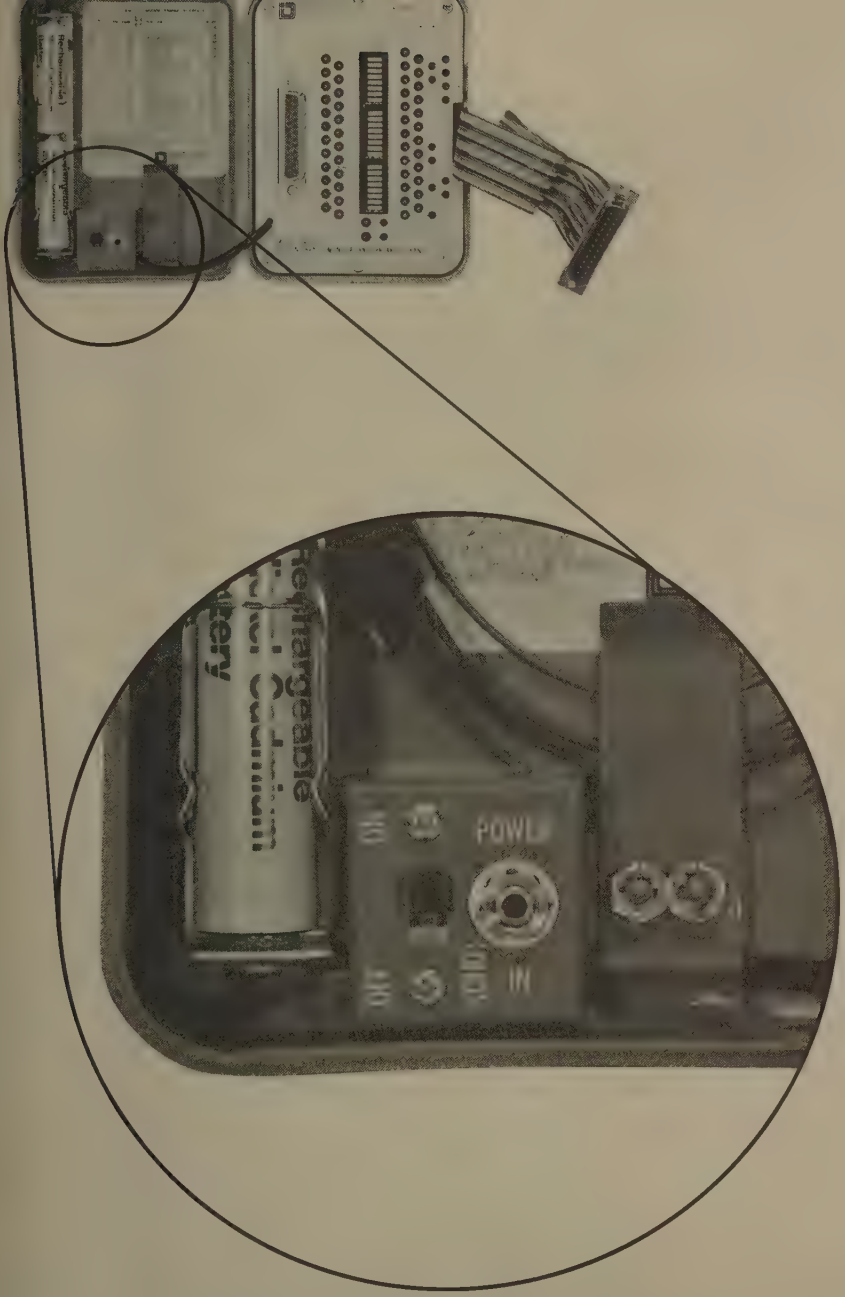


FIGURE 4.1. RECHARGEABLE UNIT OPTION

5.0 APPLICATIONS

The purpose of the Model 60 is to provide the user with a self-contained, pocket-size monitor and breakout panel in order to isolate and solve modem-terminal problems at the EIA RS-232 and CCITT V.24 Interface. The Model 60 may also be very useful for many applications in digital lab work. Several applications using the Model 60 are described in the following sections.

5.1 Monitoring the Modem-Terminal Interface

The Model 60 is transparent to the interface while it allows the operator to monitor and breakout the entire 25-wire EIA RS-232 interface.

Setup: See Figure 5.1

1) Disconnect the interface cable from the modem and plug it into the TO DTE connector on the Model 60.

2) Use the Model 60's ribbon cable, labeled TO DCE, to connect the Model 60 to the modem.

3) Switch all of the Model 60's ON/OFF switches to the ON position.

5.2 Modem Loop-Back Test

Transmit Data is looped into Receive Data at the digital side of the Modem, allowing a loop-back test to be performed on modems with no loop-back capability.

Setup: See Figure 5.2

1) Connect the Model 60 to the modem-terminal interface as described in Section 5.1.

2) Switch the Model 60's #2 and #3 ON/OFF switches to the OFF position.

3) Use a miniature jumper cable, stored in the cover of the unit, to jumper pins 2 and 3 together on the DCE side of the switches.

5.3 Monitoring EIA Line Transitions

The two LEDs associated with the IN+ and IN- inputs will show the data as it changes back and forth between a high and a low state.

Setup: Refer back to Figure 5.1

1) Connect the Model 60 to the modem-terminal interface as described in Section 5.1.

2) Using the 3-way jumper cable, stored in the cover of the unit, connect TD (or any other line) to both the IN+ and IN- inputs as shown in Figure 5.3.

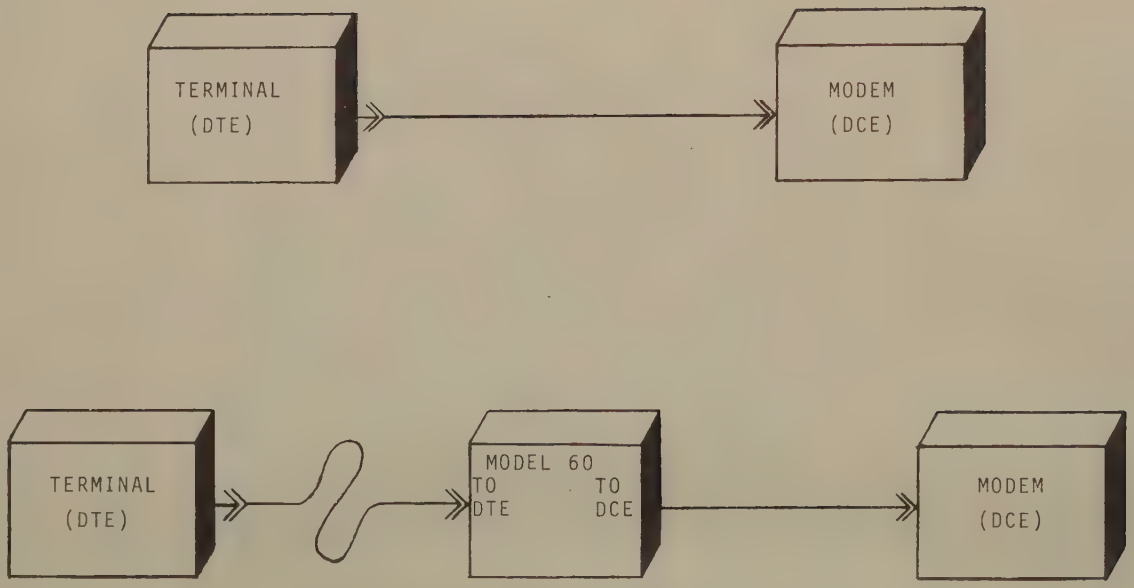


FIGURE 5.1. MONITORING THE MODEM-TERMINAL INTERFACE

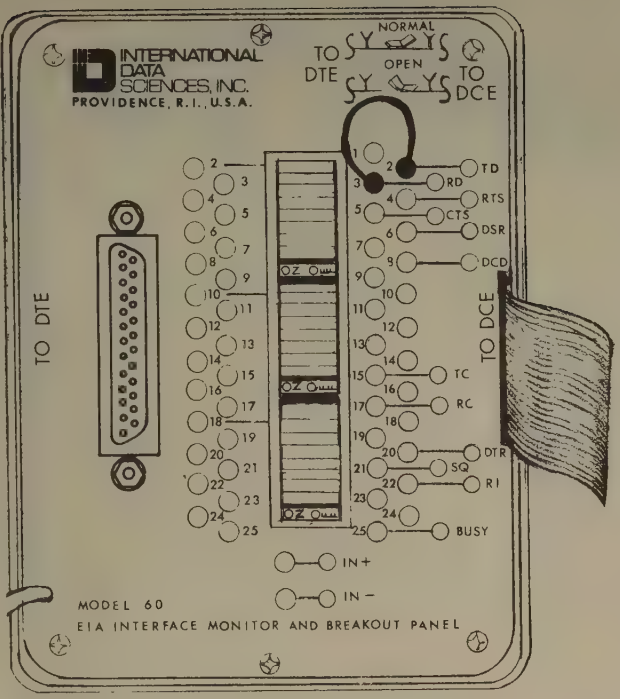


FIGURE 5.2. MODEM LOOP-BACK TEST CONNECTION

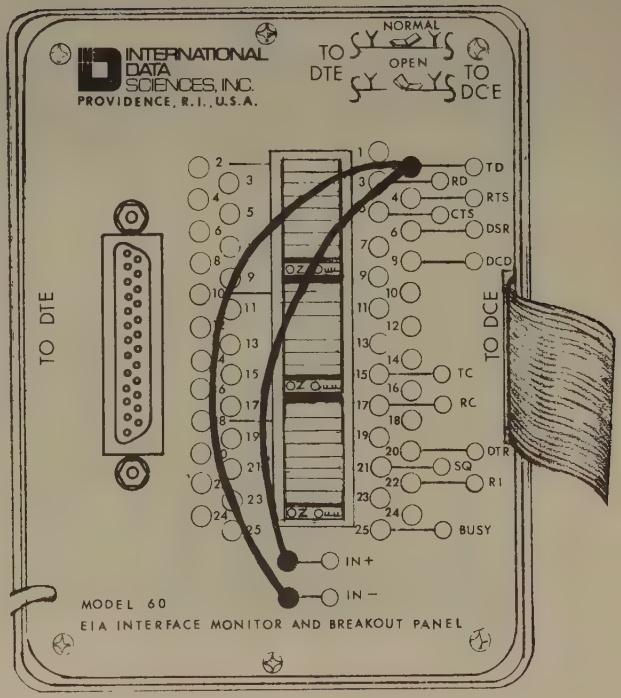


FIGURE 5.3. MONITORING EIA LINE TRANSITIONS

5.4 EIA Line Attenuation Test

A resistor attenuation network is used to test the operation of the modem or terminal EIA driver circuits under a simulated full-load condition. The LED associated with the line under test will illuminate if the driver circuits are operating properly.

Setup: See Figure 5.4-1

1) Connect the Model 60 to either the modem (DCE) or terminal (DTE) to be tested.

2) Connect one end of the resistor attenuation network, shown in Figure 5.4-2, to pin 7 (signal ground) and the other end to any signal pin to be tested.

5.5 Model 60 LED Lamp Test

Illumination of the LED indicates proper circuit operation.

Setup: See Figure 5.5

1) Use a miniature jumper cable to jumper IN- to any of the other 13 LED circuits.

5.6 EIA Signal Test

The IN+ and IN- circuits measure input signals to determine whether they meet EIA specifications. The IN+ LED will light only if the input signal is between +3V and +25V. The IN- LED will light only if the input signal is between -3V and -25V.

Setup: See Figure 5.6

1) Connect the Model 60 to the modem-terminal interface as described in Section 5.1.

2) Use a miniature jumper cable to jumper any signal line to IN+ or IN- inputs. (In Figure 5.6 the DSR line is being tested as an example.)

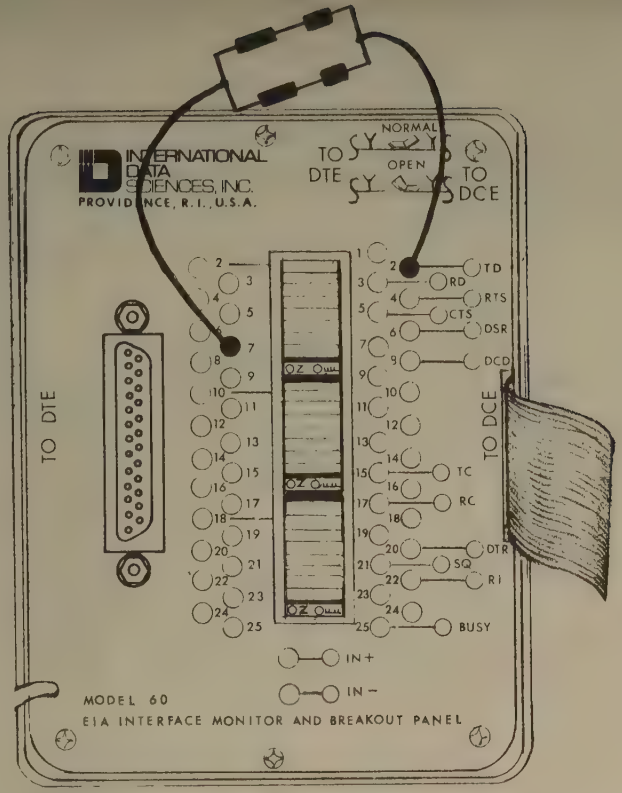
5.7 Non-Standard Modem-Terminal Interfaces

In this application a Model 60 is used where a special cable is required to interconnect the H-P 3000 terminal to a modem. This is an actual field application until a special cable can be constructed.

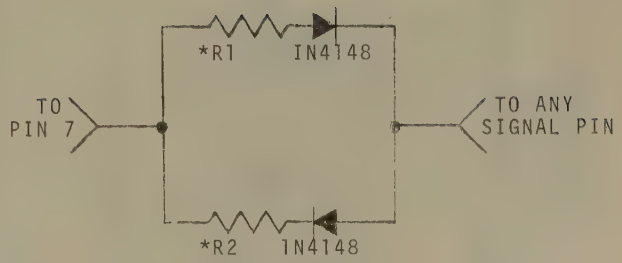
Setup: See Chart below

1) Connect the Model 60 to the modem-terminal interface as described in Section 5.1.

2) Open all switches.



IGURE 5.4-1. EIA LINE ATTENUATION TEST CONNECTION



*Value of R1 and R2 depends upon output driver voltage levels.
Typical value range: 270 Ω - 3K Ω

FIGURE 5.4-2. RESISTOR ATTENUATOR

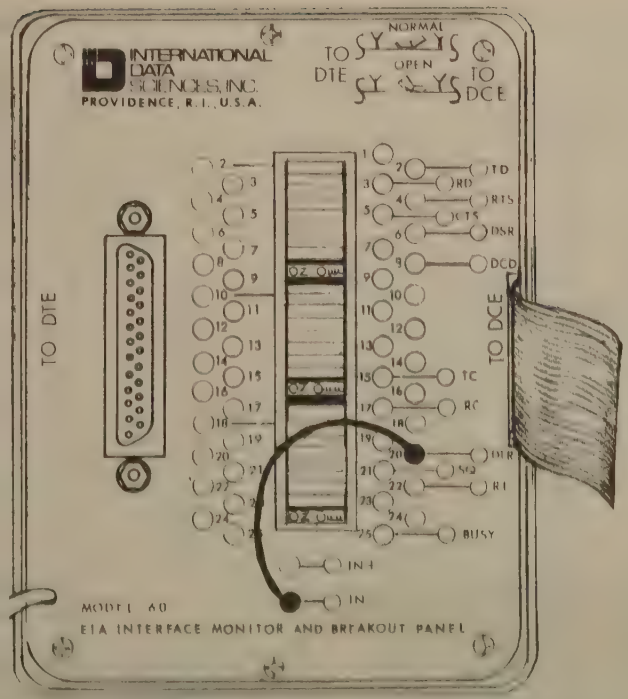


FIGURE 5.5. LED LAMP TEST

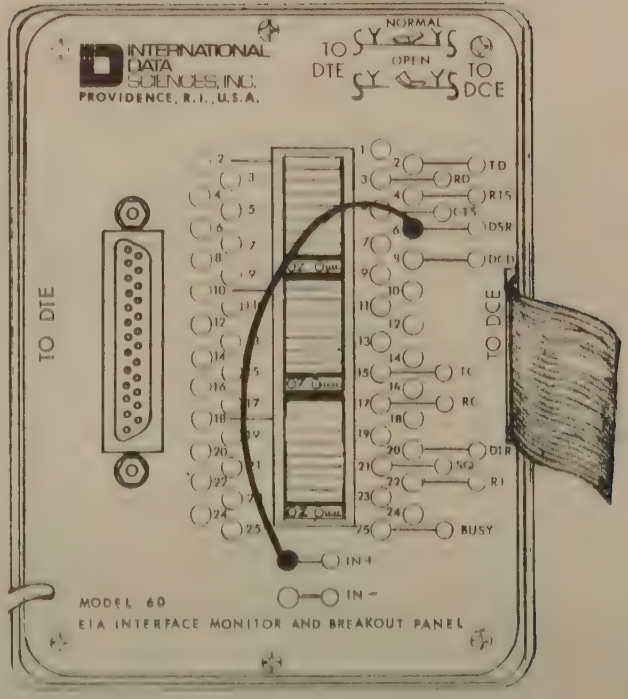


FIGURE 5.6. EIA SIGNAL TEST

3) Use jumper cables for cross-patching pins as follows:

TO DTE SIDE		TO DCE SIDE
Pin #		Pin #
2	to	3
3	to	2
4	to	8
6	to	20
7	to	7
8	to	4
11	to	12
12	to	11
20	to	6
22	to	5
23	to	23

6.0 SPECIFICATIONS

6.1 Electrical Specifications

Input Signal----------±25V as per EIA RS-232C specification ±2.5V minimum input for LED indication.

Output----------LED indication when monitored line is more than +2.5V on line and (+) positive in sensors more than -2.5V on (-) negative in sensors.

Input Impedance--------27K ohms ON state line and (+) positive IN sensors
47K ohms OFF state (-) negative IN sensor
27K ohms ON state (-) negative IN sensor

Power Source----------Two (2) AA Size Batteries
(+3V with Alkaline - +2.4V with NiCad)

Current Drain---------- 10 nano amps OFF state
106 mAmps (+12V input to all ckts)
100 mAmps (+6V input to all ckts)
7.5 mAmps (+6V input on one ckt)

Power On Switch--------U.L. file No. E43318 - Contact material barrier with hard gold plating, contact rating 1 volt 10 ma to 1.0 amp inductive at 125 VAC.
(Rechargeable Option only)

6.2 Mechanical Specifications

Size	Height: 5" (12.7 cm) Width : 3 3/4" (9.52 cm) Depth : 1 3/4" (4.45 cm)
Weight	13 ounces (370 grams) including batteries.
Housing (Case)	Durable polypropylene injection molded case/integral living hinged cover (guaranteed for 70,000,000 flex cycles). Can be dropped from a height of two feet without damage.
Front Panel	Anodized aluminum.
Power In Bracket (Rechargeable Option only)	Aluminum bracket used to mount charger receptacle and power on switch.
Power In Receptacle (Rechargeable Option only)	1/25 size of standard phone jacks, two-conductor, single closed circuit, silver plated nickel springs. Will accept 2.5 mm outside diameter phone plug.
Power On Switch (Rechargeable Option only)	Low bounce spst slide action switch, straight terminals, panel mounting ears, .77"L x .30"W x 25"D; life expectancy 100,000 actuations.

6.3 Nickel-Cadmium Battery Specifications

Type	CF15 cylindrical cell, fast charge high discharge rate, 500 milli-amp hour capacity.
Voltage	1.2V (the average voltage during discharge)
Average Service Capacity	500 milli amp hours to 1.0V (output in discharge at the 1 hour rate to an endpoint of 1.0V/cell for all cylindrical cells).
Terminals	flat contacts
Weight	0.8 ounces (22.7 grams)
Volume	0.42 cubic inches (6.9 cubic centimeters, displacement)
Cell	One cylindrical (ANSI K40) (AA Size) High rate-fast charge. (Internal resistance 30 milliohms).

Discharge Rate---------at 25°C 50mA load 10 hours (to endpoint of 0.9V)
at 25°C 100mA load 5.5 hours (to endpoint of 0.9V)

Self-Discharge---------after 20 weeks of storage 10% rated capacity will be available.
at 21°C after 20 weeks of storage 65% rated capacity will be available.

Max Temperature During Discharge--------150°F (63.5°C) battery case

Charge Rate------------at 150mA charge current full charge would take 4.5 hours for a fully discharged battery (charge voltage 2.9V)

Cycles Life------------1000 average number of charge-discharge cycles.

Max Temperature During Extended--------115°F (46.1°C) battery case.
Overcharge

A continuous overcharge for two years would result in a slightly reduced voltage curve and 65% capacity.

General----------------Sealed nickel-cadmium cells exhibit relatively constant discharge voltages over operating temperature range.
Operating and chargine at temperatures higher than specified range may be harmful to the cell.

6.4 Charging Specifications

Charger Type-----------Constant current charging is recommended on all nickel-cadmium cells. A 18V 150mA charger supplied by Astrocom is being used.

Because of use of CF type batteries, no fast charge protection circuitry is required to prevent battery damage. Fast charge cells will charge at C/3 rate (this is 166 mA charge current max without protection). At 150 mA charge current, it will take 4.5 hours to fully charge batteries, with power on switch off. (No load condition) Under full load it would take approximately 14 hours.

AC Power---------------110 VAC, 60 Hz (220 VAC, 50 Hz also available)

6.0 Temperature Specifications

Lowest operating temperature device is the M61 and the batteries. This lowers the M61 temperature spec to

Operating ---------Charge Temp - +60°F to -11°F
Temperature (+15.6°C to -24°C)
Discharge Temp - -4°F to -11°F
(-20°C to -24°C)

Storage ---------(-40°F to +140°F)
Temperature (-40°C to +60°C)

FOR MODEL 60 ONLY

Operating ---------(-40°F to +203°F)
Temperature (-40°C to +95°C)

Storage ---------(-67°F to +257°F
Temperature (-55°C to +125°C)

REPAIR SERVICE

Should your unit require repairs not covered by the original warranty, IDS will perform the repair at an hourly charge plus parts. Normal turn-around time is two weeks.

All units returned to IDS for repair will be accepted only if transportation charges are prepaid. If your firm requires a purchase order to process invoices, please include a purchase order with the units to be repaired.

Units for repair should be sent to:

International Data Sciences, Inc.
7 Wellington Road
Lincoln, Rhode Island 02865

Attn: Repair Department

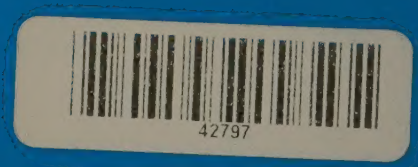
The purchaser is responsible for all transportation charges incurred in the return of the repaired unit.

For fast return, Federal Express or Emery Air Freight are recommended; otherwise, units will be returned via UPS. Return address should be clearly stated and should include name of person to the attention of whom unit will be shipped.

WARRANTY

All International Data Sciences, Inc. products are warranted against defects in material, workmanship, and component failure for one year. To receive a lifetime warranty for your Model 60, fill out and return the enclosed Warranty Registration Card within 15 days of purchase. All units repaired by IDS are warranted for 90 days following the repair service.

All units returned to IDS under this warranty require prepaid transportation charges. The purchaser is also responsible for all transportation charges incurred in returning the repaired unit to the purchaser.


42797